CLAIMS

1. A substrate for mounting an IC chip comprising:

a substrate and, as serially built up on both faces thereof, a conductor circuit and an interlaminar insulating layer in an alternate fashion and in repetition; a solder resist layer formed as an outermost layer; and an optical element mounted thereto,

wherein

an optical path for transmitting optical signal is disposed so as to penetrate said substrate for mounting an IC chip.

2. The substrate for mounting an IC chip according to Claim 1,

wherein

said optical path for transmitting optical signal is constituted by a vacancy.

3. The substrate for mounting an IC chip according to Claim 1,

wherein

said optical path for transmitting optical signal is constituted by a resin composition and a vacancy.

4. The substrate for mounting an IC chip according to Claim 1,

wherein

said optical path for transmitting optical signal is constituted by a vacancy and a conductor layer around the vacancy.

5. The substrate for mounting an IC chip according to Claim 1,

wherein

said optical path for transmitting optical signal is constituted by a resin composition, a vacancy and a conductor layer around these.

6. The substrate for mounting an IC chip according to any of Claims 1 to 5,

wherein

a position at which said optical element is mounted is on a surface of the substrate for mounting an IC chip.

7. The substrate for mounting an IC chip according to Claim 6,

wherein

said optical element is a light receiving element and/or a light emitting element.

8. The substrate for mounting an IC chip according to any of Claims 1 to 7,

wherein

an electronic component is mounted on a surface of said substrate for mounting an IC chip.

9. The substrate for mounting an IC chip according to any of Claims 1 to 8,

wherein

a micro lens is disposed on an end portion of said optical path for transmitting optical signal.

10. The substrate for mounting an IC chip according to any of Claims 1 to 9,

wherein

a cross-sectional diameter of said optical path for transmitting optical signal is 100 to 500 μm.

11. The substrate for mounting an IC chip according to any of Claims 1 to 10,

wherein

the conductor circuits with said substrate interposed

therebetween are connected to each other through a plated-through hole, and the conductor circuits with said interlaminar insulating layers interposed therebetween are connected to each other through a via-hole.

12. A manufacturing method of a substrate for mounting an IC chip, comprising:

(a) a multilayered circuit board manufacturing step of serially building up a conductor circuit and an interlaminar insulating layer on both faces of a substrate in an alternate fashion and in repetition to provide a multilayered circuit board;

(b) a through hole formation step of forming a through hole in said multilayered circuit board; and

(c) a solder resist layer formation step of forming a solder resist layer having an opening communicating with the through hole formed in said step (b).

13. The manufacturing method of a substrate for mounting an IC chip according to Claim 12, comprising:

a roughened face formation step of forming a roughened face on a wall face of the through hole formed in said step (b).

14. The manufacturing method of a substrate for mounting an IC chip according to Claim 12 or 13, comprising:

a conductor layer formation step of forming a conductor layer on a wall face of the through hole formed in said step (b).

15. The manufacturing method of a substrate for mounting an IC chip according to any one of Claims 12 to 14, comprising:

a resin composition filling step of filling an uncured resin composition into the through hole formed in said step (b).

16. The manufacturing method of a substrate for mounting an

IC chip according to any one of Claims 12 to 15, comprising:

a micro lens disposition step of disposing a micro lens on an end portion of the opening formed in said step (c).

17. A device for optical communication comprising a substrate for mounting an IC chip and a multilayered printed circuit board, wherein

an optical path for transmitting optical signal which penetrates said substrate for mounting an IC chip is formed in the substrate for mounting an IC chip.

18. A device for optical communication comprising a substrate for mounting an IC chip and a multilayered printed circuit board, wherein

said multilayered printed circuit board includes a substrate and a conductor circuit, and

an optical path for transmitting optical signal which penetrates at least the substrate is formed in said multilayered printed circuit board.

19. A device for optical communication comprising a substrate for mounting an IC chip and a multilayered printed circuit board, wherein

an optical path for transmitting optical signal which penetrates said substrate for mounting an IC chip is formed in the substrate for mounting an IC chip,

said multilayered printed circuit board includes a substrate and a conductor circuit, and

an optical path for transmitting optical signal which penetrates at least the substrate is formed in said multilayered printed circuit board.

20. The device for optical communication according to any of claims 17 to 19,

wherein

said optical path for transmitting optical signal comprises a vacancy.

21. The device for optical communication according to any of claims 17 to 19,

wherein

said optical path for transmitting optical signal comprises a resin composition and a vacancy.

22. The device for optical communication according to any of claims 17 to 19,

wherein

said optical path for transmitting optical signal comprises a vacancy and a conductor layer around the vacancy.

23. The device for optical communication according to any of claims 17 to 19,

wherein

said optical path for transmitting optical signal comprises a resin composition, a vacancy, and a conductor layer around the resin composition and the vacancy.

24. The device for optical communication according to any of claims 17 to 23,

wherein

a micro lens is disposed on an end portion of said optical path for transmitting optical signal.

25. The device for optical communication according to any of claims 17 to 24,

wherein

a cross-sectional diameter of said optical path for transmitting optical signal is 100 to 500 μm.

26. The device for optical communication according to any of

claims 17 to 25,

wherein

an optical element is mounted on said substrate for mounting an IC chip, and

a position at which said optical element is mounted is on a surface of the substrate for mounting an IC chip.

27. The device for optical communication according to claim 26,

wherein

said optical element is a light receiving element and/or a light emitting element.

28. The device for optical communication according to any of claims 17 to 27, wherein

said substrate for mounting an IC chip includes conductor circuits, interlaminar insulating layers, and a via-hole connecting the conductor circuits across said interlaminar insulating layers.

29. A device for optical communication comprising:

a substrate for mounting an IC chip on which at least an optical element is mounted; and

a multilayered printed circuit board on which at least an optical waveguide is formed,

the device for optical communication being constituted to be able to transmit optical signal between said optical waveguide and said optical element,

wherein

a sealing resin layer is formed between said substrate for mounting an IC chip and said multilayered printed circuit board.

30. The device for optical communication according to Claim 29,

wherein

said sealing resin layer has a transmissivity of 70 %/mm or more for communication wavelength light.

31. The device for optical communication according to Claim 29 or 30,

wherein

said sealing resin layer contains particles.

32. The device for optical communication according to any of claims 29 to 31,

wherein

said optical element is a light receiving element and/or a light emitting element.

33. A manufacturing method of a device for optical communication,

wherein

after separately manufacturing a substrate for mounting an IC chip on which at least an optical element is mounted, and a multilayered printed circuit board on which at least an optical waveguide is formed,

said substrate for mounting an IC chip and said multilayered printed circuit board are disposed at and fixed to such respective positions as to be able to transmit optical signal between the optical element of said substrate for mounting an IC chip and the optical waveguide of said multilayered printed circuit board, and

further, a resin composition for sealing is caused to flow between said substrate for mounting an IC chip and said multilayered printed circuit board and then a curing treatment is conducted, thereby forming a sealing resin layer.

34. A device for optical communication comprising:

a substrate for mounting an IC chip having at least an

area for mounting an optical element in which an optical element is mounted and a resin filled layer for an optical path is formed; and

a multilayered printed circuit board at which at least an optical waveguide is formed,

wherein

said device for optical communication is constituted such that optical signal can be transmitted between said optical waveguide and said optical element through said resin filled layer for an optical path.

35. The device for optical communication according to claim 34,

wherein

a sealing resin layer is formed between said substrate for mounting an IC chip and said multilayered printed circuit board.

36. The device for optical communication according to claim 35,

wherein

said sealing resin layer has a transmissivity of 70 %/mm or more for communication wavelength light.

37. The device for optical communication according to claim 35 or 36,

wherein

said sealing resin layer contains particles.

38. The device for optical communication according to any of claims 34 to 37,

wherein

at least one micro lens is disposed on a face of said resin filled layer for an optical path, said face confronting the multilayered printed circuit board.

39. The device for optical communication according to any of claims 35 to 37,

wherein

at least one micro lens is disposed on a face of said resin filled layer for an optical path, said face confronting the multilayered printed circuit board, and said micro lens has a refractive index higher than that of said sealing resin layer.

40. The device for optical communication according to any of claims 34 to 39,

wherein

said optical element is a light receiving element and/or a light emitting element.

41. A manufacturing method of a device for optical communication,

wherein

after separately manufacturing: a substrate for mounting an IC chip having at least an area for mounting an optical element in which an optical element is mounted and a resin filled layer for an optical path is formed; and a multilayered printed circuit board to which at least an optical waveguide is formed,

said substrate for mounting an IC chip and said multilayered printed circuit board are disposed at and fixed to such respective positions as to be able to transmit optical signal between the optical element of said substrate for mounting an IC chip and the optical waveguide of said multilayered printed circuit board, and

further, a resin composition for sealing is made to flow between said substrate for mounting an IC chip and said multilayered printed circuit board and then, a curing treatment is conducted, thereby forming a sealing resin layer.

42. A device for optical communication comprising:

a substrate for mounting an IC chip at which an optical path for transmitting optical signal is formed, and on one face of said substrate, an optical element is mounted; and

a multilayered printed circuit board at which at least an optical waveguide is formed,

wherein

said device for optical communication is constituted such that optical signal can be transmitted between said optical waveguide and said optical element through said optical path for transmitting optical signal.

43. The device for optical communication according to claim 42,

wherein

a sealing resin layer is formed between said substrate for mounting an IC chip and said multilayered printed circuit board.

44. The device for optical communication according to claim 43,

wherein

said sealing resin layer has a transmissivity of 70 %/mm or more for communication wavelength light.

45. The device for optical communication according to claim 43 or 44,

wherein

said sealing resin layer contains particles.

46. The device for optical communication according to any of claims 42 to 45,

wherein

a micro lens is disposed on an end portion on at least a multilayered printed circuit board side of said optical path for transmitting optical signal.

47. The device for optical communication according to any of claims 43 to 45,

wherein

a micro lens is disposed on an end portion on at least a multilayered printed circuit board side of said optical path for transmitting optical signal, and said micro lens has a refractive index higher than that of said sealing resin layer.

48. The device for optical communication according to any of claims 42 to 47,

wherein

said optical element is a light receiving element and/or a light emitting element.

49. The device for optical communication according to any of claims 42 to 48,

wherein

a resin layer for an optical path is formed inside said optical path for transmitting optical signal.

50. A manufacturing method of a device for optical communication,

wherein

after separately manufacturing: a substrate for mounting an IC chip to which an optical path for transmitting optical signal is formed, and to one face of said substrate an optical element is mounted; and a multilayered printed circuit board to which at least an optical waveguide is formed,

said substrate for mounting an IC chip and said multilayered printed circuit board are disposed at and fixed to such respective positions as to be able to transmit optical signal between the optical element of the substrate for mounting an IC chip and the optical waveguide of the multilayered printed circuit board, and

further, a resin composition for sealing is made to flow between said substrate for mounting an IC chip and said multilayered printed circuit board and then, a curing treatment is conducted, thereby forming a sealing resin layer.

51. A substrate for mounting an IC chip comprising:

a substrate, as serially built up on both faces thereof, a conductor circuit and an interlaminar insulating layer in an alternate fashion and in repetition;

a solder resist layer formed as an outermost layer; and

an optical element mounted thereto,

wherein

an optical waveguide is formed inside said substrate for mounting an IC chip, and

an optical path for transmitting optical signal which connects said optical element to said optical waveguide is formed.

52. The substrate for mounting an IC chip according to claim 51,

wherein

said optical waveguide is an organic optical waveguide.

53. The substrate for mounting an IC chip according to claim 51 or 52,

wherein

said optical path for transmitting optical signal comprises a vacancy.

54. The substrate for mounting an IC chip according to claim 51 or 52,

wherein

said optical path for transmitting optical signal comprises a resin composition and a vacancy.

55. The substrate for mounting an IC chip according to claim 51 or 52,

wherein

said optical path for transmitting optical signal comprises a resin composition.

56. The substrate for mounting an IC chip according to claim 51 or 52,

wherein

said optical path for transmitting optical signal comprises a vacancy and a conductor layer around the vacancy.

57. The substrate for mounting an IC chip according to claim 51 or 52,

wherein

said optical path for transmitting optical signal comprises a resin composition, a vacancy, and a conductor layer around the resin composition and the vacancy.

58. The substrate for mounting an IC chip according to claim 51 or 52,

wherein

said optical path for transmitting optical signal comprises a resin composition and a conductor layer around the resin composition.

59. The substrate for mounting an IC chip according to any of claims 51 to 58,

wherein

a position at which said optical element is mounted is on a surface of the substrate for mounting an IC chip.

60. The substrate for mounting an IC chip according to claim 59,

wherein

said optical element is a light receiving element and/or a light emitting element.

61. The substrate for mounting an IC chip according to any of claims 51 to 60,

wherein

an electronic component is mounted on a surface of said substrate for mounting an IC chip.

62. The substrate for mounting an IC chip according to any of claims 51 to 61,

wherein

a micro lens is formed on an end portion of said optical path for transmitting optical signal or in said optical path for transmitting optical signal.

63. The substrate for mounting an IC chip according to any of claims 51 to 62,

wherein

a cross-sectional diameter of said optical path for transmitting optical signal is 100 to 500 μm.

64. The substrate for mounting an IC chip according to any of claims 51 to 63,

wherein

the conductor circuits across said substrate are connected to each other through a plated-through hole, and the conductor circuits across said interlaminar insulating layers are connected to each other through a via-hole.

65. A manufacturing method of a substrate for mounting an IC chip, wherein

a substrate, an optical waveguide, and a lamination manufactured through at least the following steps (a) to (c) are built up in this order:

(a) a conductor circuit lamination formation step of serially building up conductor circuits and interlaminar insulating layers on a base material layer in an alternate fashion and in repetition to provide a conductor circuit lamination;

(b) an opening formation step of forming an opening which becomes an optical path for transmitting optical signal in said conductor circuit lamination; and

(c) a solder resist layer formation step of forming a solder resist layer having an opening communicating with the opening formed in said step (b), on one face of said conductor circuit lamination.

66. A manufacturing method of a substrate for mounting an IC chip, comprising:

(a) an optical waveguide formation step of forming an optical waveguide on a substrate on which conductor circuits are formed;

(b) a multilayered circuit board manufacturing step of serially building up interlaminar insulating layers and conductor circuits on the substrate, on which said optical waveguide is formed, in an alternate fashion and in repetition to provide a multilayered circuit board;

(c) an opening formation step of forming an opening which becomes an optical path for transmitting optical signal in said multilayered circuit board; and

(d) a solder resist layer formation step of forming a solder resist layer having an opening communicating with the opening formed in said step (c) on one face of said multilayered circuit board.

67. The manufacturing method of a substrate for mounting an IC chip according to claim 65 or 66, comprising:

a roughened face formation step of forming a roughened face on a wall face of the opening which becomes said optical path for transmitting optical signal.

68. The manufacturing method of a substrate for mounting an IC chip according to any of claims 65 to 67, comprising:

a conductor layer formation step of forming a conductor layer on a wall face of the opening which becomes said optical path for transmitting optical signal.

69. The manufacturing method of a substrate for mounting an IC chip according to any of claims 65 to 68, comprising:

a resin composition filling step of filling an uncured resin composition into the opening which becomes said optical path for transmitting optical signal.

70. The manufacturing method of a substrate for mounting an IC chip according to any of claims 65 to 69, comprising:

a micro lens formation step of forming a micro lens on an end portion of the opening which becomes said optical path for transmitting optical signal.

71. The manufacturing method of a substrate for mounting an IC chip according to any of claims 65 to 69, comprising:

a micro lens formation step of forming a micro lens in the opening which becomes said optical path for transmitting optical signal.